Optimal Initial Conditions for Coupling Ice Sheet & Earth System Models

Problem

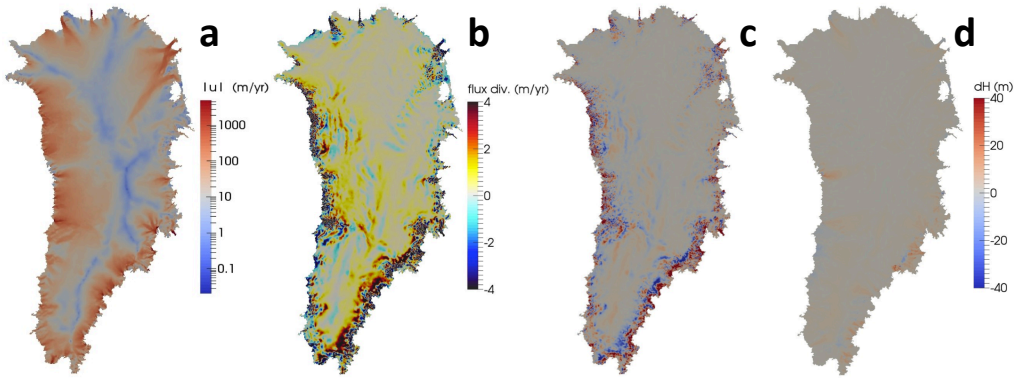
Standard ice sheet model initialization techniques lead to a “shock” and non-physical transients upon coupling to Earth Systems Models (ESMs)

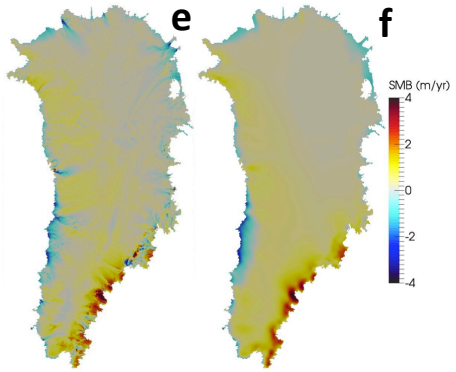
Approach

Derive and apply a new, formal, PDE-constrained optimization approach that minimizes:

- mismatch between modeled and observed ice sheet velocities
- mismatch between modeled flux divergence and surface mass balance forcing (SMB; accumulation less melting) from ESMs
- mismatch between model and observed basal topography fields, constrained by observational error estimates

Modeled Greenland velocity field (a), flux divergence (b), and transient thickness change (c) using standard optimization. Reduced thickness change with new method shown in (d).





Improved model flux divergence (e) when using new method (compare to (b) above). Ideally, flux divergence exactly balances SMB forcing from climate model, which is shown in (f).

Impact

New approach provides the first practical solution to the long-standing problem of obtaining realistic initial conditions when coupling ice sheet models and ESMs

Perego, M., **S.F. Price**, and **G. Stadler**. 2014. Optimal Initial Conditions for Coupling Ice Sheet Models to Earth System Models. *J. Geophys. Earth Surf.*, doi:10.1002/2014JF003181.